doi.org/10.22498/pages.26.2.91

New research directions for the PAGES C-PEAT working group

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College Station, USA, 10-13 May 2018

Members of the C-PEAT working group met at Texas A&M University to define their research plan for Phase 2. The past three years have led to the development and publication of a large database containing over 500 peat records that have been primarily used to (1) reconstruct Holocene carbon and nitrogen sequestration rates across the northern peatland domain, and (2) connect centennial- and millennial-scale changes in carbon sequestration rates to key climatic forcings and environmental controls (Charman et al. 2012; Loisel et al. 2014; Treat et al. 2015). C-PEAT is in the process of making its entire peatland database available on WDS-PANGAEA; 164 sites are readily available under the project name PAGES_C-PEAT. Those same peat profiles have also been ingested in the International Soil Carbon Network's database (ISCN) and are accessible on its website. These two data sharing activities took place during a "data hackathon" shortly before this workshop. An article in *Earth System Science Data*, describing the entire database, is in development.

Building on the success of Phase 1, there is a clear need to grow C-PEAT's research scope. Workshop participants identified future tasks that ultimately aim to further integrate peatlands into land-surface models:

Expand the peatland database to encompass sites from the tropics and extra-tropics. C-PEAT now includes a large group of scientists with expertise in tropical peatlands. We know that humans are a major agent of change in tropical peatlands; our team intends to focus its effort on (a) quantifying carbon stocks and fluxes, (b) evaluating peatland ecosystem services, and (c) measuring the impact of land management on these peatlands. A paleo perspective is essential to develop a better functional understanding of these ecosystems and link their dynamics with global carbon cycling and land-use change.

Predict peatland responses to natural and anthropogenic disturbance. Workshop participants agreed that "sensitive processes" such as (a) peatland dynamics that govern decadal-scale vertical peat accumulation and net carbon balance, and (b) margin dynamics that control horizontal peat development (expansion vs. contraction) need to be further connected to disturbance regime including fire, permafrost thaw, invasion by new species, drainage, prescribed burning, and other land-management scenarios. Here, the paleo perspective acquired during Phase I will be used to compare and contrast the importance of climatic forcings, environmental controls, and land management on peat formation and carbon sequestration. Workshop participants are preparing a manuscript that addresses these new research directions and highlights the relevance of peatland dynamics in land-surface models.

Further develop and promote the use of multi-proxy peatland records as paleoclimatic archives. The peat cores included in the C-PEAT database could be used in conjunction with those from other archives such as lake sediments, tree rings and ice cores. For example, there is an array of traditional and novel peat-based proxies for temperature and hydrology. Of particular interest to the C-PEAT group is (a) a combination of compound-specific stable isotope measurements to back-calculate changes in rainfall regimes (Amesbury et al. 2015), (b) a suite of novel organic biomarkers that are sensitive to temperature and pH or that provide insight into the carbon cycle (Naafs et al. 2017), and (c) the integration of more-traditional proxies such as plant macrofossils and testate amoebae into process-based peat models such as DigiBog (Baird et al. 2012) and the Holocene Peat Model (Frolking et al. 2010) to further understand the encoding of these proxies into the peat matrix over time. Many of these datasets are already integrated to WDS-Neotoma.

Thus far, the C-PEAT working group has been associated with "environmental research" in the PAGES science structure (Fig. 1), as peatlands are key biosphere ecosystems that interact with the climate and introduce feedbacks into the Earth system. While this remains true, Phase 2 brings peat towards the center of the triangle (Fig. 1), as this working group is integrating land-use change and natural disturbance.

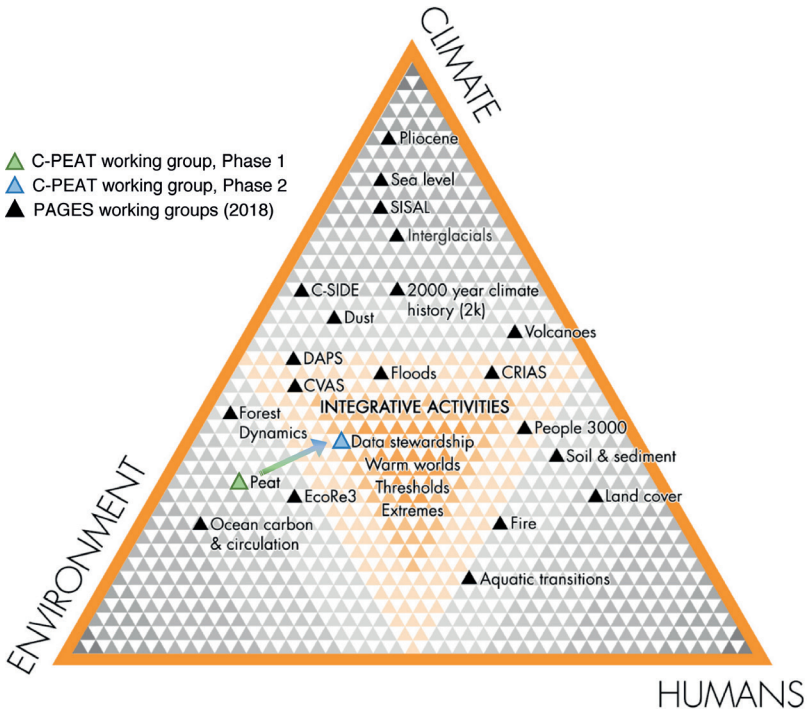

Figure 1: A new, more-integrative place for the C-PEAT working group within PAGES' science structure. This change for Phase 2 reflects the inclusion of tropical and extra-tropical peatlands, which are largely impacted by land management, and the development of new peat-based paleoclimatic proxies.

ACKNOWLEDGEMENTS

We thank PAGES, INQUA, and Texas A&M's Department of Geography for financial and logistical support.

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